22 PAINT

22.1 Introduction to Paint, Coatings and Polymers

22.1.1 Objectives

Through completion of this module the trainee will develop the theoretical knowledge to be conversant in:

- History and use of protective/decorative coatings and polymers;
- Paint, coatings and polymer terminology;
- Manufacturing processes and applications of paints and polymers; and
- Chemical formulations and compositions of various paints, coatings and polymers

22.1.2 Required Readings

An enormous amount of background reading is required, the majority of which should be done prior to discussions with the trainer.

22.1.2.1 Bentley, John, "Composition, manufacture and use of paint", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 7, pp. 123-141.

22.1.2.2 Crown, David A., The Forensic Examination of Paints and Pigments, Springfield, IL., Charles C. Thomas, 1986.

22.1.2.3 Deaken, Donna, "Automotive Body Primers: Their Application in Vehicle Identification," Journal of Forensic Sciences, Vol. 20, No. 2, April 1975, pp. 283-287.

22.1.2.4 Hare, Clive H., "Anatomy of Paint", Materials Technology, November 1989.

22.1.2.5 Lear, James B., "Analysis of Paints", Journal of Coatings Technology, Vol. 53, No. 674, March 1981, pp. 51-57.

22.1.2.6 McBane, Bruce N., "Automotive Coatings", Federation Series on Coatings Technology, 1987.

22.1.2.7 Moenssens, Andre A., and Inbau, Fred E., Scientific Evidence in Criminal Cases, 2nd ed., Mineola, NY, Foundation Press, 1978. Chapter 8 I. Introduction pp. 397-399; II. Instrumentation and Methods of Analysis pp. 399-405; V. Paint pp.417-421.

22.1.2.8 Morgans, W.M., Outlines of Paint Technology, Volume 1: Materials, New York, NY, John Wiley & Sons, 1982.

22.1.2.9 Morgans, W.M., Outlines of Paint Technology, Volume 2: Finished Products, New York, NY, John Wiley & Sons, 1984.

22.1.2.10 Prane, Joseph A., "Introduction to Polymers and Resins", Federation Series on Coatings Technology, 1986.

22.1.2.11 Sullivan, D. A., "Water and Solvent Evaporation from Latex and Latex Paint Films," Journal of Paint Technology, Vol. 47, No. 610, November 1975, pp. 60-67.

22.1.2.12 Thornton, John I., "Forensic Paint Examination", Saferstein, Richard, ed., Forensic Science Handbook, Volume 1, 2nd edition, 2002, Chapter 8, pp. 429-452.

Also, appropriate units from the Federation Series of Coatings, Technology and referral to the Paint and Coatings Dictionary, as necessary.

22.1.3 Questions

The trainee will provide written answers to the following questions:

- Briefly describe the differences among the following types of paint:
  - Automotive Paint
  - Structural (architectural) Paint
  - Bicycle Paint
  - Maintenance Paint
  - Marine Paint
  - Aircraft Paint

- What is a polymer?
- What is a paint?
- What is the difference between a paint and a coating?
- What are the two primary purposes of paint?
- What makes a paint unique?
- What is a paint vehicle?
- What is a paint binder?
- What is a pigment?
- What is an extender pigment? List 5 of the more common extenders.
- What is the major resin used in a paint formulation?
- What is a paint additive? List at least 3.
- What is a paint drier? List at least 5.
- What is the difference between a thermosetting resin and a thermoplastic resin?
- What is the most widely used white paint pigment? Name the two forms of this white pigment. How can these two forms of white paint pigment be distinguished from each other?
- What metal pigment is used in metallic motor vehicle paint?
- What is a primer?
- What is a primer surfacer used for in automotive paints?
- What is a substrate?
- Name three types of latex polymers.
- What is meant by the term “Let Down” in the paint industry?
- Is a wetting agent a vehicle or a binder?
- Name several other synthetic binders (other than alkyds) that are used in paints.
- Which white pigment is used as a mildew inhibitor? In flame or fire retardant paints?
- What is the primary function of the solvent in paint?
- What does a taupe primer in an OEM finish indicate?
- What type of paint did GM, Ford, Chrysler and American Motors historically use and what type of paint do they use now as OEM finishes?

22.1.4 Evaluation

22.1.5.1 The trainer will review the written answers to the questions with the trainee.

22.1.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.1.5.3 The trainee will be quizzed orally upon the subject matter.

22.2 Recognition, Collection, Packaging and Controls

22.2.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Describe to an investigator the proper way to collect paint evidence;
- Recommend proper packaging for paint evidence; and
- Detail the proper controls that are to be taken and why.

22.2.2 Required Readings

22.2.2.1 Saferstein, Richard, Ed., Forensic Science Handbook, Volume II, Englewood Cliffs, NJ, Prentice-Hall, Inc. 1988. Chapter 4, pp. 161-208.

22.2.2.2 Trace Evidence Handbook, Internal Publication, pp. 3-8, 66-80.

22.2.2.3 Virginia Division of Forensic Science Evidence Handling Guide:
- Examples of Trace Evidence Submissions
- Trace Evidence Sections XXX and XXX

22.2.3 Questions

The trainee will provide written answers to the questions on pp. 71 and 72 of the Trace Evidence Handbook.

22.2.4 Practical Exercises

22.2.4.1 Demonstrate the druggist or paper fold to the trainer.

22.2.4.2 Explain to the trainer the information given to an officer over the phone if asked what evidence should be collected in an automotive hit and run involving two vehicles. Involving a vehicle and a pedestrian.

22.2.4.3 Explain to the trainer the information given to an officer for a breaking and entering with a painted door and tools?

22.2.5 Evaluation

22.2.5.1 The trainer will review the written answers to the questions with the trainee.

22.2.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.2.5.2 Review of practical exercises.

22.3 Stereomicroscopic Evaluation of Paint

22.3.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Determine the physical properties of paints and/or polymers to include: color, texture, thickness, layer sequence, metallic/nonmetallic/pearlescent, other surface characteristics;
- Take appropriate notes;
- Use a stereomicroscope properly;

- Work with extremely small samples;
- Discern colors accurately, including pastels;
- Distinguish OEM finishes from repaints; and
- Recognize and recover paint from debris, from a smear on clothing and from a tool.

22.3.2 Required Readings

22.3.2.1 Thornton, John I., "Forensic Paint Examination", Saferstein, Richard, ed., Forensic Science Handbook, Volume 1, 2nd edition, 2002, Chapter 8, pp. 452-472, 473-478.

22.3.3 Questions

The trainee will provide written answers to the following questions:

- What different methods could be used to determine the layer structure of a paint chip when viewing the chip microscopically?
- What characteristics can be observed from a microscopic examination of a paint chip?
- What is a good method to observe a clear coating in the layer of a paint?
- What are some noticeable differences between primers and the finish coats in motor vehicle paints?
- How many primers would generally be expected in the original finish of a motor vehicle paint?
- Describe the differences between an original finish paint particle and a paint particle from a repainted vehicle.

22.3.4 Practical Exercises

22.3.4.1 At the stereomicroscope, the trainer will demonstrate/discuss color, texture and layer structure. Included in this discussion will be different light sources (e.g. UV/VIS; ALS), different lighting angles (e.g. oblique, 90 degrees) and different color background (black/white; complementary color). Demonstration by the trainer will include manipulation of paint particles to expose the layer structure in a variety of ways.

22.3.4.2 The trainer will discuss with the trainee how to take appropriate notes, how to properly use worksheets and what abbreviations are in standard use for paint analysis.

22.3.4.3 The trainer will provide several paint samples that are large enough to allow the trainee to familiarize themselves with the manipulation of paint particles using the stereomicroscope.

22.3.4.4 The trainer will provide ten different paint samples for the trainee to examine using the stereomicroscope. A summary chart(s) will be prepared which will include the number, color and descriptions of texture for each layer(s) in the samples as well as a pictorial representation. Additionally, an assessment as to whether the sample is an OEM or a refinish will be included. The paint worksheet may be used but is not required.

22.3.4.5 The trainer will provide a number of different types of paints and/or coatings for the trainee to examine using the stereomicroscope which the trainee will describe in notes and drawings. These will include, but are not limited to, body filler (body putty), bicycle paint, marine paint, "house" paint, Virginia license plate paint, and a sample of a stopsign or other reflective material.

22.3.4.6 The trainer will provide a "debris" sample with a known number of paint particles. The trainee will search the debris and report the number and color of the particles recovered and whether they appear to be automotive in origin or not. The trainer may also include other materials that might typically be encountered in a debris sample and request that the trainee recover and list these as well.

22.3.4.7 The trainer will provide the trainee with a paint smear(s) on clothing and paint transferred to a tool for recovery of the paint. This may be accomplished through simulated case samples or by having the trainee work closely with the trainer using actual evidentiary material.

22.3.5 Evaluation

22.3.5.1 The trainer will review the written answers to the questions with the trainee.

22.3.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.3.5.3 Review of practical exercises.

22.4 Microsolubility and Microchemical Testing

22.4.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Safely prepare microsolubility and microchemical reagents;
- Correctly classify a paint layer in terms of its solubility;
- Determine the microchemical properties of paints and/or polymers; and
- Discuss the applicability of solvent testing to the classification of paints as OEM or refinish.

22.4.2 Required Readings

22.4.2.1 Thornton, J., et. al., "Solubility Characterization of Automobile Paints", Journal of Forensic Sciences, Vol. 28, No. 4., 1983, pp. 1004-1007.

22.4.3 Questions

The trainee will provide written answers to the following questions:

- What is the difference between a microsolubility test and a microchemical test?
- What microchemical reactions are expected from an acrylic lacquer? A nitrocellulose lacquer? An acrylic enamel and an alkyd enamel? A latex paint?
- What paint pigment gives a "false positive" diphenylamine reaction?
- What in an alkyd paint is responsible for a positive alkyd test?
- What two microchemical tests could be used to compare red paints?
- What does a nitrocellulose primer in an automotive paint indicate?
- What white pigment bubbles in HCl?
- What blue pigment turns green in diphenylamine or conc. H_2SO_4?
- Cite the reference for the LeRosen test?

22.4.4 Practical Exercises

22.4.4.1 The trainee will assemble the necessary solvents and acids and prepare the necessary reagents. The trainee will become familiar with the requirements and will perform appropriate QC checks.

22.4.4.2 The trainer will provide the trainee with known samples of paint as follows: an enamel, a solution lacquer, a dispersion lacquer, and a nitrocellulose lacquer. These knowns will be tested using chloroform, acetone, toluene and diphenylamine. A table correlating general paint type with solubilities and reaction in diphenylamine will be prepared.

22.4.4.3 The trainer will provide the trainee with a variety of known paint samples to be tested in LeRosen, concentrated H_2SO_4 and HNO_3.

22.4.4.4 The trainer will provide the trainee with at least ten different paint samples which the trainee will characterize as to colors, textures, types, layer sequence, OEM/refinish, solubility and microchemical reactions. Record results on a paint worksheet.

22.4.4.5 The trainer will provide the trainee with at least three different sets of "K" and a "Q" paint samples. The trainee will examine the paints and characterize as to colors, textures, types, layer sequence, OEM/refinish, solubility and microchemical reactions to determine whether or not they match. Record results on paint worksheets.

22.4.5 Evaluation

22.4.5.1 The trainer will review the written answers to the questions with the trainee.

22.4.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.4.5.3 Review of practical exercises.

22.5 Fracture Matches

22.5.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Describe the difference between class and individual characteristics;
- Describe how a fracture match may be made and why it is considered conclusive that the two objects were at one time a part of the same unit;
- Document a positive fracture match; and
- Write reports for positive fracture matches, negative fracture matches and negative fracture matches where additional testing has been or will be completed.

22.5.2 Required Readings

22.5.2.1 VanHoven, Harvey A., and Fraysier, Harry D., "The Matching of Automotive Paint Chips by Surface Striation Alignment", Journal of Forensic Sciences, Vol. 28, No. 2, 1983, pp. 463-467.

22.5.3 Questions

The trainee will provide written answers to the following questions:

- Is a fracture match considered to be a conclusive identification? Why?

22.5.4 Practical Exercises

22.5.4.1 The trainer will demonstrate a fracture match of a plastic automotive lens.

22.5.4.2 The trainee will complete the fracture match section of the training manual.

22.5.4.3 The trainee will be given test samples of plastic automotive lens and test samples of paint fragments and they will be asked to fracture match the pieces, if possible.

22.5.5 Evaluation

22.5.5.1 The trainer will review the written answers to the questions with the trainee.

22.5.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.5.5.3 Review of practical exercises.

22.6 Fluorescence

22.6.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Explain the theory and operation of fluorescence microscopy; and
- Successfully assess and document known and questioned paint samples.

22.6.2 Required Readings

22.6.2.1 Rost, F.W.D., Fluorescence microscopy, Vol. 1, Cambridge University Press, Great Britain, 1996, pp. 1-63 and 104-128.

22.6.3 Questions

The trainee will provide written answers to the following questions:

- Is fluorescence a physical, chemical or optical property? Explain.
- Explain when a Q sample would or would not be excluded from being associated with a K sample when observing differences in fluorescence.

22.6.4 Practical Exercises

22.6.4.1 The trainee will complete the fluorescence microscopy section of the training manual.

22.6.4.2 The trainer will demonstrate the examination of a K and Q paint sample using fluorescence microscopy. This demonstration will include the use of the Fluorescence worksheet.

22.6.4.3 The trainee will analyze the three K and Q paint sets from Section 22.4.4.5.

22.6.5 Evaluation

22.6.5.1 The trainer will review the written answers to the questions with the trainee.

22.6.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.6.5.3 Review of practical exercises.

22.7 Fourier Transform Infrared Spectrophotometry (FT-IR)

22.7.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Explain the theory and operation of the FT-IR; and

- Successfully analyze a variety of paint samples from intact layers to smears.

22.7.2 Required Readings

22.7.2.1 Beverage, Alexander, Fung, Tony and MacDougall, Donald, "Use of infrared spectroscopy for the characterisation of paint fragments", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 10, pp. 183-225, 233-241.

22.7.2.2 Ryland, Scott G., "Infrared Micrsospectroscopy of Forensic Paint Evidence" in Practical Guide to Infrared Microspectroscopy, Humecki, Howard J., ed., Marcel Dekker, Inc., New York, pp. 163-243.

22.7.2.3 Smalldon, K. W., "The Identification of Paint Resins and Other Polymeric Materials from the Infra Red Spectra of their Pyrolysis Products," Journal of the Forensic Science Society, Vol. 9, (no date given), pp. 135-140.

22.7.3 Questions

The trainee will provide written answers to the following questions:

- Complete the questions in the FTIR section of the training manual.
- A component present in approximately what concentration will generally not be seen in an FTIR spectrum?
- What are the advantages and disadvantages of the FTIR analysis of paint?

22.7.4 Practical Exercises

22.7.4.1 The trainee will successfully complete the FTIR section of the training manual.

22.7.4.2. The trainee will be given three PDQ samples of Virginia samples that are in the database which they will analyze via FTIR. The spectra will be interpreted and compared against the database spectra.

22.7.4.3 The trainee will sample and obtain FTIR spectral data for at least three paint smears.

22.7.4.4 The trainee will analyze samples from a previous paint proficiency; said samples to be used for PGC. (See 22.8.4.1)

22.7.5 Evaluation

22.7.5.1 The trainer will review the written answers to the questions with the trainee.

22.7.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.7.5.3 Review of practical exercises.

22.8 Pyrolysis Gas Chromatography (PGC)

22.8.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Explain the theory and operation of the gas chromatograph with the pyroprobe accessory;
- Determine how sample size effects reproducibility; and
- Understand and be able to articulate when it is appropriate to use PGC for paints.

22.8.2 Required Readings

22.8.2.1 Cardosi, P.J., "Pyrolysis-Gas Chromatographic Examination of Paints," Journal of Forensic Sciences, Vol. 27, No. 3, 1982, pp. 695-703.

22.8.2.2 CDS Technical Paper 091373, "Application of Pyrolysis-GC to the Identification of Automobile Paint," Chemical Data Systems, Oxford, PA.

22.8.2.3 Challinor, John M., “Pyrolysis techniques for the characterisation and discrimination of paint fragments”, Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 19, pp. 165-182.

22.8.2.4 Jain, N. C., et. al., "Identification of Paints by Pyrolysis-GC," Journal of Forensic Science Society, Vol. 5, 1965, pp. 102-109.

22.8.2.5 Levy, E. J., "The Analysis of Automobile Paints by Pyrolysis-GC," Analytical Pyrolysis, 1977.

22.8.2.6 Tsgue, Shin, "Characterization of Polymers by Pyrolysis/High Resolution Gas Chromatography with Fused-Silica Capillary Columns," Chromatography Forum, November-December 1986, pp. 44-50.

22.8.2.7 Wolf, Clarence J., et. al., "Pyrolysis Gas Chromatography of Polymers," Analytical Chemistry, Vol. 52, No. 3, March 1980, pp. 348A-358A.

22.8.3 Questions

The trainee will provide written answers to the following questions:

- A component present in approximately what concentration will generally not be seen in a pyrogram?
- What are the advantages and disadvantages of the PGC analysis of paint?

22.8.4 Practical Exercises

22.8.4.1 The trainee will be given a large enough paint sample to prepare and run at least three times in order to observe reproducibility. The trainee will run half the starting sample size and record observations regarding reproducibility.

22.8.4.1 The trainee will be given samples from a previous paint proficiency which they will analyze and compare to data that they have generated via FTIR for these samples.

22.8.5 Evaluation

22.8.5.1 The trainer will review the written answers to the questions with the trainee.

22.8.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.8.5.3 Review of practical exercises.

22.9 Scanning Electron Microscopy/Energy Dispersive X-Ray (SEM/EDS)

22.9.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Explain the theory and operation of the SEM/EDS system and its application to paint analysis;

- Explain how to prepare samples for analysis via the SEM/EDS system; and
- Explain the appropriate approach and common pitfalls to data interpretation.

22.9.2 Required Readings

22.9.2.1 Henson, M. Lynn and Jergovich, Tammy A., "Scanning electron microscopy and energy dispersive X-ray spectrometry (SEM/EDS) for the forensic examination of paints and coatings", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 11, pp. 243-272.

22.9.2.2 Ward, Dennis C., and Carlson, Timothy L., "Paint Analysis Using the Scanning Electron Microscope," Crime Laboratory Digest, F.B.I. Laboratory, Washington, DC, 1983, pp.2-6.

22.9.3 Questions

The trainee will provide written answers to the following questions:

- How does sample preparation affect resulting data?
- How small a percentage of an element can generally be detected by this instrumental technique?
- Are paint samples generally carbon coated? Why or why not?

22.9.4 Practical Exercises

22.9.4.1 The trainee will work with an examiner qualified to use the SEM/EDS for an orientation to the instrument and hands-on training.

22.9.4.2 The trainee will analyze one of the three K and Q paint sets from Section 22.4.4.5. Alternatively, items from an actual case may be analyzed in lieu of samples from the previous paint sets.

22.9.5 Evaluation

22.9.5.1 The trainer will review the written answers to the questions with the trainee.

22.9.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.9.5.3 Review of practical exercises.

22.10 Colorimetry

22.10.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Explain the theory and operation of the colorimeter;
- Determine when a sample is or is not suitable for colorimetry;
- Analyze samples with the colorimeter.

22.10.2 Required Readings

See Colorimetry section of the training manual plus,

22.10.2 Stoecklein, Wilfried, "The role of colour and microscopic techniques for the characterisation of paint fragments", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 8, pp. 143-156, 162-163.

22.10.3 Questions

The trainee will provide written answers to the following questions:

- Approximately what size sample is necessary to perform colorimetry?
- Describe some surface characteristics that are incompatible with colorimetry analysis.

22.10.4 Practical Exercises

22.10.4.1 The trainee will complete the colorimetry section of the training manual.

22.10.4.2 The trainee will successfully analyze paint samples in at least three different paint case scenarios.

22.10.5 Evaluation

22.10.5.1 The trainer will review the written answers to the questions with the trainee.

22.10.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.10.5.3 Review of practical exercises.

22.11 Microspectrophotometry (MSP)

22.11.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Analyze paint samples via the microspectrophotometer; and
- Determine when MSP of paints may be useful.

22.11.2 Required Readings

22.11.2.1 Eyring, Michael B., "Visible Microscopical Spectrophotometry in the Forensic Sciences", Saferstein, Richard, ed., Forensic Science Handbook, Volume 1, 2nd edition, 2002, Chapter 6, pp. 354-364, 367-376

22.11.2.2 Stoecklein, Wilfried, "The role of colour and microscopic techniques for the characterisation of paint fragments", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 8, pp. 156-161.

22.11.3 Questions

The trainee will provide written answers to the following questions:

- Explain why MSP is not routinely used for paint analysis in the Virginia Division of Forensic Science.

22.11.4 Practical Exercises

22.11.4.1 The trainee will complete the microspectrophotometry section of the training manual.

22.11.4.2 The trainer will provide the trainee with a paint sample which will analyzed in both reflectance and transmittance.

22.11.4.2 The trainee will choose a color of paint and will run three visually close, but actually different, paint samples of that color.

22.11.5 Evaluation

22.11.5.1 The trainer will review the written answers to the questions with the trainee.

22.11.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.11.5.3 Review of practical exercises.

22.12 Paint Data Query (PDQ)

22.12.1 Objectives

Through completion of this module the trainee will have developed and demonstrated theoretical knowledge and/or practical skills to:

- Describe the history and development of the PDQ;
- Describe how samples are collected and what information is necessary for a paint sample's submission to the PDQ database;
- Successfully demonstrate a layer system query and a fill-in-the-blank query; and
- Search a paint sample and report results of that search.

22.12.2 Required Readings

22.12.2.1 Beverage, Alexander, Fung, Tony and MacDougall, Donald, "Use of infrared spectroscopy for the characterisation of paint fragments", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 10, pp. 225-233.

22.12.2.2 Bishea, Gregory A., Buckle, J.L., and Ryland, Scott G., "International Forensic Automotive Paint Database", TWGMAT communication, obtained from the FBI Chemistry Unit, Oct. 1998.

22.12.2.3 Buckle, J.L., MacDougall, D.A., and Grant, R.R., "PDQ – Paint Data Queries: The History and Technology Behind the Development of the Royal Canadian Mounted Police Forensic Laboratory Services Automotive Paint Database", Canadian Society of Forensic Science Journal, Vol. 30, No. 4, (1997), pp. 199-212.

22.12.2.4 PDQ User's Manual.

22.12.3 Questions

The trainee will provide written answers to the following questions:

- What are the requirements for a paint sample for submission to the paint database?
- What are the requirements for a forensic paint case sample in order to be searched via the PDQ?
- What information may be derived from a successful PDQ search?
- How is the information from a successful PDQ search reported in a Certificate of Analysis?

- What are the three major uses of the PDQ?

22.12.4 Practical Exercises

22.12.4.1 The trainee will use the three samples previously analyzed in 22.7.4.2 to search the database and report their results.

22.12.5 Evaluation

22.12.5.1 The trainer will review the written answers to the questions with the trainee.

22.12.5.2 The trainer and the trainee will review and discuss the pertinent points of each of the required readings.

22.12.5.2 Review of practical exercises.

22.13 Supervised Casework

The trainee will work at least ten forensic cases as a technician for a qualified paint examiner. The trainer should ensure as much variety in the casework as is practicable.

22.14 Forensic Significance of Paint

The trainer and the trainee will discuss the interpretation of paint evidence and its relevance and weight in reports and in testimony. Discussions will include probabilities versus possibilities.

22.14.1 Required Readings

22.14.1.1 Thornton, John I., "Forensic Paint Examination", Saferstein, Richard, ed., Forensic Science Handbook, Volume 1, 2nd edition, 2002, Chapter 8, pp. 472-473.

22.14.1.2 Willis, Sheila, McCullough, John and McDermott, Sean, "The interpretation of paint evidence", Forensic Examination of Glass and Paint Analysis and Interpretation, Caddy, Brian, ed., Taylor and Francis, New York, 2001, Chapter 12, pp. 273-287.

22.15 Report Writing

The trainer will review and discuss with the trainee the standard report wording in Section 12.8 of the Trace Evidence Standard Operating Procedures.

The trainer will provide ten cases previously examined by other qualified paint examiners for the trainee to review and discuss with the trainer.

The trainee will draft report wording as a part of the analysis of their training sets as well as when performing supervised casework.

Report writing will be evaluated throughout the training period by the trainer.

22.16 Paint Presentation and Oral Examination

The trainee will prepare a presentation of approximately 20-30 minutes in length which they will present to a group consisting of qualified paint examiners, the QA Coordinator, as available, and any Director that chooses to attend. The presentation may cover either: the general theory and application of the instrumentation used in paint analysis; the forensic examination of paints and polymers; or a current topic that has been approved by the Section Chief that is of interest to the forensic paint community.

The trainee will field questions regarding their presentation topic as well as questions related to any/all aspects of their paint training.

22.17 Competency Evaluation and Mock Trial

22.17.1 As the trainee progresses through paint training, they will begin to process training sets as they would for casework to include drafting a Certificate of Analysis. There will be a minimum of three of these "case" files completed prior to issuance of the final competency test.

22.17.2 Using one or all of the "cases" from 22.17.1, the trainee will undergo a series of "mini-mock trial" practice sessions with qualified examiners from the Trace Evidence Section. It may be useful to include practice sessions with examiners from Sections other than Trace Evidence.

22.17.3 The trainee will be provided with a final competency test for analysis. This test will mimic actual casework to the maximum extent possible and will include at least two matching paint samples and one paint sample that cannot be associated with the others. Additionally, this test will include at least one positive fracture match for those trainees who have not previously completed documented fracture match training.

The trainee will analyze the final competency test samples and issue a Certificate of Analysis based upon their findings. The trainee will be called upon to defend their results via testimony in a formal mock trial setting. The mock trial will typically be scheduled about two weeks after the paint presentation and oral examination.

22.17.4 The trainer and the trainee will review the mock trial video tape in a timely fashion.

22.18 Certification

Upon successful completion of the training process, following Section 15.6 of the Division of Forensic Science, Quality Manual, the trainee will be issued a written certification memorandum.

22.19 Reading List

22.19.1 Caddy, Brian, Ed., Forensic Examination of Glass and Paint Analysis and Interpretation, Taylor and Francis, New York, 2001.

22.19.2 Cardosi, P.J., "Pyrolysis-Gas Chromatographic Examination of Paints," Journal of Forensic Sciences, Vol. 27, No. 3, 1982, pp. 695-703.

22.19.3 CDS Technical Paper 091373, "Application of Pyrolysis-GC to the Identification of Automobile Paint," Chemical Data Systems, Oxford, PA.

22.19.4 Crown, David A., The Forensic Examination of Paints and Pigments, Springfield, IL., Charles C. Thomas, 1986.

22.19.5 Deaken, Donna, "Automotive Body Primers: Their Application in Vehicle Identification," Journal of Forensic Sciences, Vol. 20, No. 2, April 1975, pp. 283-287.

22.19.6 Federation Series of Coatings Technology, Units 1-27, Federation of Societies for Paint Technology, varying copyright dates.

22.19.7 Hare, Clive H., "Anatomy of Paint," Materials Technology, November 1989.

22.19.8 Infrared Spectroscopy - Its Use in the Coatings Industry, Federation of Societies for Paint Technology, Philadelphia, PA., 1969.

22.19.9 Jain, N. C., et. al., "Identification of Paints by Pyrolysis-GC," Journal of Forensic Science Society, Vol. 5, 1965, pp. 102-109.

22.19.10 Lear, James B., "Analysis of Paints," Journal of Coatings Technology, Vol. 53, No. 674, March 1981, pp. 51-57.

22.19.11 Levy, E. J., "The Analysis of Automobile Paints by Pyrolysis-GC," Analytical Pyrolysis, 1977.

22.19.12 McBane, Bruce N., "Automotive Coatings," Federation Series on Coatings Technology, 1987.

22.19.13 Moenssens, Andre A., and Inbau, Fred E., Scientific Evidence in Criminal Cases, 2nd ed., Mineola, NY, Foundation Press, 1978.

22.19.14 Morgans, W. M., Outlines of Paint Technology, Vol. 1: Materials, New York, NY, John Wiley & Sons, 1982.

22.19.15 Morgans, W. M., Outlines of Paint Technology, Vol. 2: Finished Products, New York, NY, John Wiley & Sons, 1984.

22.19.16 Paint and Coatings Dictionary, Federation of Societies for Coatings Technology, Philadelphia, PA, 1978.

22.19.17 Prane, Joseph A., "Introduction to Polymers and Resins," Federation Series on Coatings Technology, 1986.

22.19.18 Rost, F.W.D., Fluorescence microscopy, Vol. 1, Cambridge University Press, Great Britain, 1996.

22.19.18 Saferstein, Richard, Ed., Forensic Science Handbook, Volume 1, 2nd edition, Pearson Education, Inc., New Jersey, 2002.

22.19.19 Saferstein, Richard, Ed., Forensic Science Handbook, Volume 2, Englewood Cliffs, NJ, Prentice-Hall, Inc., 1988.

22.19.20 Smalldon, K. W., "The Identification of Paint Resins and Other Polymeric Materials from the Infra Red Spectra of their Pyrolysis Products," Journal of the Forensic Science Society, Vol. 9, (no date given), pp. 135-140.

22.19.21 Sullivan, D. A., "Water and Solvent Evaporation from Latex and Latex Paint Films," Journal of Paint Technology, Vol. 47, No. 610, November 1975, pp. 60-67.

22.19.22 Thornton, J., et. al., "Solubility Characterization of Automobile Paints, "Journal of Forensic Sciences, Vol. 28, No. 4, 1983 pp. 1004-1007.

22.19.23 Trace Evidence Handbook, Division of Forensic Science, 2nd ed., internal publication, May 1984.

22.19.24 Tsgue, Shin, "Characterization of Polymers by Pyrolysis/High Resolution Gas Chromatography with Fused-Silica Capillary Columns," Chromatography Forum, November-December 1986, pp. 44-50.

22.19.25 VanHoven, Harvey A., and Fraysier, Harry D., "The Matching of Automotive Paint Chips by Surface Striation Alignment," Journal of Forensic Sciences, Vol. 28, No. 2, 1983, pp. 463-467.

22.19.26 Virginia Division of Forensic Science, Evidence Handling Guide, internal publication, July 2002.

22.19.27 Ward, Dennis C., and Carlson, Timothy L., "Paint Analysis Using the Scanning Electron Microscope, "Crime Laboratory Digest, F.B.I. Laboratory, Washington, DC, 1983, pp.2-6.

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